BULLETIN NO. 160. JANUARY 18, 1899.

THE NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION,
W. A. WITHERS, A. M., ACTING DIRECTOR.

DIGESTION EXPERIMENTS.

F. E. EMERY.

RALEIGH, N. C.

508

Publications will be sent to any address in North Carolina upon application

NORTH CAROLINA COLLEGE OF AGRICULTURE AND MECHANIC ARTS,

RALEIGH, N. C.

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

The Director's office is in the main building of the College. Telephone No. 135 C. The street cars pass within one hundred yards of the College building.

The Station is glad to receive any inquiries on agricultural subjects. *Address all communications to the Agricultural Experiment Station, and not to individuals.* They will be referred to the members of the Station staff most competent to answer them.

DIGESTION EXPERIMENTS.

F. E. EMERY, AGRICULTURIST.

CRAB GRASS HAY ALONE, AND IN COMBINATION WITH COWPEA MEAL, CORN BRAN, AND RICE BRAN; FIRST AND SECOND GROWTHS OF GREEN RAPE.

[For previously reported workin this line from this Station, see Bulletins No. 80, 87, 97, 118, and 148.]

INTRODUCTION.

Crab grass hay is distinctively a Southern forage plant. It is an annual, growing vigorously in the wet period of midsummer, and seeding abundantly. Even when cut for hay it is believed usually to have reached such a stage of maturity that the next year's growth is assured from seed dropped. The ripening, as also the haying, is accompanied by such perfect weather that the straw is bright and fresh looking and even when seed has ripened, and the hay has past its best estate for digestion, its looks indicate an earlier stage of development than has actually been attained. Thus the crab grass hay, the digestion of which was reported in Bulletin No. 148, was about on a par with cotton-seed hulls In these trials crab grass hay has been used to feed with some by-products which are produced in the South and in North Carolina. The feeding value of these articles is considerable—we have sought to determine how great, and to establish a basis for comparisons between these and other by-products which are better known. Cowpea meal, one of the articles subjected to digestion for this bulletin, is not a by-product. It is the cowpea ground for feeding, and represents the full composition of the cowpea. The price is usually high for feed but can be cheapened by use of machinery in harvesting.

Peanut Meal, a by-product designed for cattle food was tried, but sheep would not eat enough of it even when they were fed nothing else to keep them from starving. Whether the fault lies with the sheep or this sample was old and the composition changed we do not know. It is hoped an opportunity to make another trial of this food may be found.

Corn and Rice Bran. These were the ordinary by-products of the corn and rice mills.

Green Rape. The growth and feeding of this plant is a new departure in the South, as indeed it is in most parts of this country. It was but just beginning to be grown generally in the Northwest,

following the lead of Prof. Thomas Shaw, of the Minnessota Experiment Station, when a fine crop was produced at Occoneechee Farm, Hillsboro, N. C., and it began to be cultivated at this Station. Seed and directions for growing the crop can be found with leading seedsmen.

The rape digested in these experiments was grown from late fall sowing and some of it from transplanted plants set in rows and cultivated. With us the most satisfactory crops come from drilled rows set close for one or two cultivations, and the plants when spreading out cover the whole ground, then feed off on the ground. This may be done with cattle or swine, but here sheep have been used exclusively, except that this Spring (1898) calves have been turned out with the sheep.

Success in growing rape may be attained by following the directions given for growing cabbage in Bulletin No 132, though less care and attention is bestowed on this forage plant, which must be grown cheaply and on a larger scale. It will pay, however, to sow in drills, thin the plants, and cultivate while it is small. In the North this crop is sown broadcast after grain harvest for fall grazing. In our dry, hotter climate two or three careful cultivations of drills will give better and more abundant food than to allow the plants to struggle with heat and weeds in broadcast seeding, unless the sowing is done in connection with cowpea vines for a partial shade during the early life of the rape.

As in Bulletin No. 148, table 1 contains all the analyses for the experiments reported here.

The feeding for these experiments was mostly done by R. D. Patterson, Jr., B. S., assisted at times by R. E. L. Crenshaw and F. E. Emery. The analytical work has been done by H. K. Miller, M. S., and G. S. Fraps, B. S., the calculations and writing up by F. E. Emery.

The sheep used in these experiments were the same as were used in the experiments reported in Bulletin No. 148. They were fed in the same stalls, in the same way, and in periods of about the same length. Good health and ready appetites were prominent characteristics during these experiments, except that, although hungry and in good health, the sheep refused the peanut meal persistently, and refused to subsist on corn bran fed alone, though they ate this bran readily when fed with hay.

(1) Digestion of Crab Grass Hay by Sheep, Nos. 3 and 4.

Date of experiment March and April, 1897. Crab grass hay fed 32 ounces daily to each sheep. Total period 25 days. Collections were made during the last ten days. The weights of the two sheep were maintained. Sheep No. 1 was turned out because it had reached other food and was uneasy in confinement. Sheep No. 2 made a

slight gain, loose, in box stall. All analyses are given in table 1. The coefficients of digestibility are as worked out in Table No. 2 as follows: For dry matter 54.9 per cent; for Ash 51.8 per cent; for Protein 32.0 per cent; for Albuminoids 28.8 per cent; for fat 35.6 per cent; for nitrogen, free extract, 52.8 per cent; crude fiber 64.4 per cent. Nutritive Ratio 1 : 19.5.

(2) Digestion of Crab Grass Hay and Cowpea Meal by Sheep, Nos. 3 and 4.

Date of experiment April and May, 1897. Crab grass hay fed, 16 ounces per day to each sheep. Cow-pea meal fed, 16 ounces per day to each sheep. Total period, 20 days. Collections were made the last ten days. The weights of the sheep were maintained and from the less amounts of food taken while the last weights were being obtained, there appears to have been a loss on two of them.

	Sheep No. 2.	Sheep No. 3.	Sheep No. 4.
Weights of sheep at close of 1st period	74.8	63.2	74.
Weights at the end of the 2nd period	69.8	66.7	71.3

All analyses are given in Table No. I. Coefficient of digestibility as worked out in Table No. III, and are as follows:

	Dry Matter. Per Ct.	Ash. Per Ct.	Protein (N×6.25). Per Ct.	Fat (Ether Extract. Per Ct.	N Free Extract. Per Ct.	Crude Fiber. Per Ct.
For the ration	70.9	45.9	70.5	54.7	76.5	64.3
For the pea meal	86.6	33.5	82.0	73.9	93.1	64.0

Nutritive ratio of ration of crab grass hay, 1 to 1.03; cowpea meal, based on dry matter, 1: 4.65.

Nutritive ratio of cowpea meal, 1: 3.2.

(3) Attempt to Feed Peanut Meal, a Coarsely Ground By-Product, Failed.

(4) Digestion of Crab Grass Hay and Corn Bran.

Date of experiment May and June, 1897. Crab grass hay 12 ounces, corn bran 28 ounces, per day. Total period 20 days. Collections were made the last ten days.

	Sheep No. 1.	Sheep No. 2.	Sheep No. 3.	Sheep No. 4.
Weight of sheep at beginning of this period	69.7	67.	54.	64.5
Weight of sheep at middle of period	79.	73.	62.7	69.7
Weight of sheep at beginning of 5th period	81.7	74.8	63.	69.

The weights are taken during all the time the sheep are not harnessed. Hence the three weights, taken at the beginning

of each preliminary period, serve to indicate whether there has been loss or gain during the previous experiment.

The short period after experiment 2, occupied by the failure (3), and two days when sheep were unsuccessfully tried on corn bran alone were so many days with very little food. During this time the weights fell off, and the three weights at the beginning of period (4) were low. The weights in the middle of the period an average of the three last, before harnesses were put on for collections, show that the normal weights had been recovered and that the sheep in harness fairly held their weights during the collection period, while sheep Nos. 1 and 2 continued to gain some in weight. All analyses are given in Table I, while the coefficients of digestibility, as worked out in Table IV, and are as follows:

	Dry Matter. Per Ct.	Ash. Per Ct.	Protein (N×6.25) Per Ct.	Fat (Ether Extract.) Per Ct.	N Free Extract. Per Ct.	Crude Fiber. Per Ct.
For the ration....	66.1	16.5	48.7	69.1	74.5	59.7
For corn bran...	70.5	.....	53.4	72.3	79.6	53.1

Nutritive ratio for corn bran, 1: 14.

Nutritive ratio of ration of crab grass hay 1 to corn bran 2⅓, on dry matter basis is 1: 14.57.

(5) (6) DIGESTION OF GREEN DWARF ESSEX RAPE BY SHEEP NOS. 3 AND 4, AND NOS. 1 AND 2.

Date of experiment June, 1897.

Green rape fed 9 pounds daily to each sheep in three even feeds. Rape plucked fresh for every feed in imitation of grazing.

The first day only 6 pounds were thus fed. Total period, 20 days. Collections were made the last ten days of the period with each pair of sheep.

	Sheep No. 1.	Sheep No. 2.	Sheep No. 3.	Sheep No. 4.
Weight of sheep, average 1st, 2nd and 3rd days.....81.7		74.8	63.0	69.0
Weight of sheep, average 8th, 9th and 10th days....74.		71.2	59.5	64.8
Weight of sheep, average at beginning of 6th period, 77.3		76.3		

During the progress of this feeding it seemed as though the animals would have consumed more if it had been offered, but the 9 pounds had been expected to cloy the appetites of the smaller eaters before the period was out. Sheep Nos. 1 and 2 were fed through a second period on rape, in which these heartiest sheep were fed 5 pounds each of rape at a feed three times per day. Some waste resulted from this feed, enough to indicate *this* as truly ad-libitum feeding, if the 3 pounds per feed *had not been* for the other sheep. Sheep Nos. 3 and 4 were not fed through this part of the period and no records were taken of their weights when harnesses were removed. Thus the last weights were lost, and the mid period weights indicate losses in weight for all the sheep. Prac-

tically no water was drunk when sheep were fed on green rape, though the sheep took water from three to eight times each in the twenty days, mostly during the first week. Samples of rape were taken every day for analysis the same as it was cut for sheep, taking the entire product of one plant to be analyzed. The rape was increased to sheep Nos. 1 and 2, while the collections were being made with Nos. 3 and 4. The total time for sheep Nos. 1 and 2 was 36 days. Collections were made the last ten days.

These analyses will be found in Table I. The coefficients of digestibility, as worked out in Table V, are as follows:

	Dry Matter. Per cent.	Ash. Per cent.	Protein (N×6.25) Per cent.	Albuminoids Alb N×6.2.	Fat (Ether Extract.) Per cent.	N Free Extract. Per cent.	Crude Fiber. Per cent.
For sheep 3 and 4.....	88.5	76.5	90.2	86.6	54.2	93.8	90.
For sheep 1 and 2.....	81.0	48.9	87.4	86.1	42.8	89.9	84.
Mean of 4 sheep	84.8	62.7	88.8	86.4	48.5	92.0	87.

DIGESTION OF CRAB GRASS HAY AND RICE BRAN.

Date of experiment July, 1897. Each of the four sheep received 12 ounces of hay and 12 ounces of rice bran per day in three equal feeds. Total period 20 days. Collections were made during the last 10 days.

	Sheep No. 1.	Sheep No. 2.	Sheep No. 3.	Sheep No. 4.
Average weights of sheep at beginning	75.5	69.0	63.0	68.3
Average weights of sheep before two collections	83.	77.5	65.3	69.0
Weight of each sheep at end of experiment	81.	78.*	67.8	71.0

* Only one weight and not an average of three weights as, usual.

The weights of sheep would seem to indicate that the sheep were all gaining during this period.

The analyses are collected in Table 1. The coefficients of digestibility, as calculated from Table 6, are as follows:

	Dry Matter per cent.	Ash per cent.	Protein (4 x 6.25) per cent.	Fat ether ex. per cent.	N—Free Extract per cent.	Crude Fiber per cent.
For the Ration.....	59.7	26.3	52.4	82.3	66.0	56.0
For Rice Bran.....	64.7	2.4	62.9	88.6	78.2	29.2

Nutritive ratio of ration when dry matter was consumed in the proportion of 1 hay to 1.05 of rice bran, 1: 10.13.

Nutritive ratio of rice bran, 1: 7.48.

TABLE I.—SHOWING PERCENTAGE COMPOSITION OF FOODS, WASTE, AND SOLID EXCREMENT.

Farm Number.	No. of Analysis.		Water.	Dry Matter.	DRY MATTER CONTAINS					
					Ash.	Protein (N × 6 25.)	Albuminoids (Alb. N × 6.25.	Fat. (Ether Extract.)	Nitrogen Free Extract.	Crude Fiber.
755	754	Crab grass hay	9.86	90 14	8.01	7.73	7.66	1.86	46.15	36.25
756	753	Crab grass hay, Sheep No. 3	10 76	79.24	8 21	7.70	7.22	1.75	45.19	37.15
793	814	Waste crab grass hay	9.16	90.84	7.69	8.39	8.26	2 10	47.01	34.81
795	816	Waste crab grass hay, Sheep No. 4	9.25	90.75	7.61	8 16	7.85	2.15	48.17	33 91
	762	Solid excrement, Sheep No. 3	74.77	25.23	10.60	16 28	16 28	2.96	44.98	25.18
	763	Solid excrement, Sheep No. 4	83.01	16.99	11 37	17 29	17.29	2.77	44.84	24.23
771	761	Waste crab grass hay and cowpea meal, Sheep No 4	9.52	90.43	10.33	12.98	11.26	2.34	38.94	35.42
	819	Green rape, Je. 20–30 '97	81.52	18 48	13.07	23.04	16.22	4 42	46.41	13.06
	824	Waste rape, Sheep No. 3	88 25	11.75	16.02	10.15	6.74	1.36	54.72	17.75
	823	Waste rape, Sheep No. 4	85.78	14.22	34 77	18.21	10.64	2.29	31.28	13.45
	913	Solid excrement, Sheep No. 3	61.40	38.60	27.60	18.26	17.75	17.34	25.48	11.72
	912	Solid excrement, Sheep No. 4	75.44	24.56	25.33	21.22	20.08	18 00	24 44	11 01
	820	Green rape, July	85 46	14.54	14.68	27.93	21.87	4 25	42.49	10 55
	822	Waste green rape, Sheep No. 1	81.44	18.56	33.51	23.14	16 73	3.32	28 65	11.38
	821	Waste green rape, Sheep No. 2	86 30	13.70	22.19	26.32	16 48	3.80	33.51	14.18
	910	Solid excrement, Sheep No. 1	70.87	29.13	38 02	17.17	16.40	13.57	21.89	9.35
	911	Solid excrement, Sheep No. 2	74.42	25.58	39.12	16.48	15.84	12.21	23 81	8.38
759	759	Cowpea meal	12 63	87.37	3 86	25.47	24.68	1.82	64 63	4.22
899	918	Waste rice bran, Sheep No. 1	8.13	91.87	9.20	14.80	14.56	10.80	51.66	11.54
746	755	Waste crab grass hay, Sheep No. 3	9.73	90 27	7.78	7.07	6.93	1 58	36.77	46 80
	757	Solid excrement, Sheep No. 3	63.98	36.02	8 96	12.38	11.75	2.83	49.83	26.00
	915	Solid excrement, Sheep No. 2	73.55	26.45	15.58	12 25	11.95	2.51	41.15	28.51
	914	Solid excrement, Sheep No. 1	72.23	27.77	16.02	14 16	13.95	3.36	40.39	26.07
	818	Solid excrement, Sheep No. 4	76.20	23.80	9.76	14.78	14.78	4.37	49.45	21.64
	815	Solid excrement, Sheep No. 3	74.98	25.02	9.98	14.48	14.23	4.92	49.24	21.38
748	756	Waste crab grass hay, Sheep No. 4	12.03	87.97	7.75	8.73	7.82	2.12	45.44	35.96

TABLE I.—CONTINUED.

Farm Number.	No. of Analysis.		Water.	Dry Matter.	DRY MATTER CONTAINS					
					Ash.	Protein (N × 6.25.)	Albuminoids (Alb. N × 6.25.)	Fat. (Ether Extract.)	Nitrogen Free Extract.	Crude Fibre.
	758	Solid excrement, Sheep No. 4	74.16	25.84	8.88	11.15	11.15	2.24	49.28	28.45
	760	Waste hay and meal, Sheep No 3	11.82	88.18	8.10	8.28	7.65	1.79	47.18	34.65
	812	Corn bran	10.80	89.20	2.66	10.95	10.90	6.48	69.46	10.45
794	813	Waste corn bran, Sheep No. 3	10.42	89.58	4.42	13.43	13.40	7.16	64.52	10.47
796	817	Waste corn bran, Sheep No. 4	10.01	89.99	4.36	13.02	12.65	6.05	64.72	11.85
	917	Rice bran	10.22	89.78	9.17	15.04	14.90	11.94	51.75	12.10
	919	Waste crab grass hay, Sheep No. 1	8.29	91.71	9.02	10.84	6.68	4.49	45.09	30.56

TABLE II.—SHOWING NUTRIENTS CONSUMED AND EXCRETED IN GRAMS WITH PERCENTAGE DIGESTED.
(First Experiment, March and April, 1897, Crab grass hay alone).

SHEEP No. 3.

No. of Analysis.		Total Amount. *Grams.	Dry Matter. Grams.	DRY MATTER CONTAINS IN GRAMS. Ash.	Protein (N × 6.25).	Albuminoids (Alb. N × 6.25).	Fat (Ether Extract).	N-Free Extract.	Crude Fiber.
753	Crab grass hay fed in 10 days	9072.	8095.9	664.7	623.4	584.5	141.7	3658.5	3007 6
755	Waste crab grass hay in 10 days	3195 5	2845.8	221.4	201.2	197.2	45.0	1046.4	1331.8
	Total consumed		5250.1	443 3	422.2	387 3	96 7	2612 1	1675.8
757	Total solid excrement in 10 days	6660 2	2399.0	215.0	297.0	281.9	67.9	1195.4	623.7
	Total digested		2851.1	228.3	125 2	105.4	28 8	1416.7	1052.1
	Per cent. digested		**54 31**	**51 50**	**29 65**	**27 21**	**29 78**	**54 24**	**62 78**

SHEEP No. 4.

753	Crab grass hay fed in 10 days	9072.0	8095.9	664.7	623 4	584.5	141 7	3658.5	3007.6
756	Waste crabgrass hay in 10 days	1005.1	881.2	68.5	77.2	69.1	18.7	401.8	318.0
	Total consumed		7214.7	596.2	546 2	515.4	123 0	3256.7	2689.6
758	Total solid excrement in 10 days	12439.3	3214.3	285.4	358.4	358.4	72.0	1584.0	914.5
	Total digested		4000.4	310.8	187.8	157 0	51.0	1672.7	1775.1
	Per cent. digested		**55.45**	**52.13**	**34 38**	**30 46**	**41 46**	**51 36**	**66 00**
	Mean per cent. digested by both animals		**54.9**	**51.8**	**32 0**	**28.8**	**35 6**	**52 8**	**64 4**

Mean nutritive ratio, 1:19.5.

* 28.35 grams are equal to 1 ouuce. 453.6 grams are equal to 1 pound.

TABLE III.—Showing Nutrients Consumed and Excreted in Grams with Percentages Digested.
(Second Experiment Digestion Crab grass hay and Cowpea meal fed 1 to 1).

Sheep No. 3.

No. of Analysis.		Total Amount. Grams.	Dry Matter. Grams.	Dry Matter Contains in Grams.					
				Ash.	Protein (N × 6.25).	Albuminoids (Alb. N × 6.25).	Fat (Ether Extract).	N-Free Extract.	Crude Fiber.
754	Crab grass hay fed in 10 days..	4536.0	4088.8	327.5	316.1	313.2	76.1	1887.0	1482.2
759	Cowpea meal fed in 10 days	4536	3963.1	153 0	1009.4	978.1	72 1	2561.4	167.2
	Total fed in 10 days.	9072	8051 9	480.5	1325.5	1291.3	148.2	4448.4	1649.4
760	Waste hay in 10 days, 3.	350.5	317.0	25.7	26 2	24.3	5.7	149.6	109.8
	Total consumed		7734.9	454.8	1299.3	1267.0	142 5	4298.8	1539.6
762	Total solid excrement in 10 days, 4	8605.1	2170.9	230.1	353 4	353 4	64.3	976.5	546.6
	Total digested		5564.0	224.7	945.9	913.6	78.2	3322.3	993.0
	Digested from crab grass hay, first experiment		2070.7	156.3	92.8	90.2	25.1	917.3	883.4
	Digested from cowpea meal		3493.3	68.4	853.1	823.4	53.1	2405 0	109.6
	Per cent. of ration digested		71 93	49.41	72.80	72.11	54.88	77.28	64.50
	Per cent. of cowpea meal digested		88 15	44.70	84.51	84.18	73.65	93 89	65.55

TABLE III—CONTINUED.

SHEEP NO. 4.

No. of Analysis.		Total Amount. Grams.	Dry Matter. Grams.	DRY MATTER CONTAINS IN GRAMS. Ash.	Protein (N × 6.25).	Albuminoids (Alb. N × 6.25).	Fat (Ether Extract).	N-Free Extract.	Crude Fiber.
754	Crab grass hay fed in 10 days	4536.	4088.8	327.5	316.1	313.2	76.1	1887.0	1482.2
759	Cowpea meal fed in 10 days	4536.	3963.1	153.0	1009.4	978.1	72.1	2561.4	167.2
	Total fed in 10 days	9072.	8051.9	480.5	1325.5	1291.3	148.2	4448.4	1649.4
761	Waste hay in 10 days	26.	23.5	2.4	3.1	2.6	.6	9.2	8.3
	Total consumed		8028.4	478.1	1322.4	1288.7	147.6	4439.2	1641.1
763	Total solid excrements in 10 days	14278.1	2425.2	275.7	419.3	419.3	67.2	1075.3	587.6
	Total digested		5603.2	202.4	903.1	869.4	80.4	3363.9	1053.5
	Digested from crab grass hay		2231.8	168.4	100.2	89.5	26.9	991.5	949.2
	Digested from cowpea meal		3371.4	34.0	802.9	779.9	53.5	2372.4	104.3
	Per cent. digested from ration		**69.79**	**43.33**	**68.29**	**67.46**	**54.47**	**75.78**	**64.19**
	Per cent. digested from cowpea meal		**85.07**	**22.22**	**79.54**	**79.74**	**74.20**	**92.23**	**62.38**
	Mean per cent. digested from ration		**70.9**	**45.9**	**70.5**	**69.8**	**54.7**	**76.5**	**64.30**
	Mean per cent. digested from cowpea meal		**86.6**	**33.5**	**82.0**	**82.0**	**73.9**	**93.1**	**64.0**

Mean nutritive ratio of ration of cowpea meal to crab grass hay consumed in proportion of 1 to 1.03 on dry matter 1: 4.94.

Mean nutritive ratio of cowpea meal 1: 3.2.

TABLE IV.—SHOWING NUTRIENTS CONSUMED AND EXCRETED IN GRAMS WITH PERCENTAGES DIGESTED.
(Fourth Experiment, Digestion of Crab grass Hay and Corn Bran.)

SHEEP No. 3.

No. of Analysis.		Total Amount. Grams.	Dry Matter. Grams.	DRY MATTER CONTAINS IN GRAMS.					
				Ash.	Protein N × 6.25.	Albuminoids (Alb. N × 6.25).	Fat (Ether Extract).	N Free Extract.	Crude Fiber.
753	Crab grass hay fed in 10 days	3402.	3035.6	249.2	233.8	219.2	53.1	1371.9	1127.8
812	Corn bran fed in 10 days	7938.	7080.7	188.3	775.3	771.8	458 8	4918.3	739.9
	Total fed in 10 days	...	10116.6	437.5	1009.1	991.0	511.9	6290.2	1867.7
813	Waste bran	1257.9	1126 8	49.8	151.3	151.0	80.7	727.0	118.0
814	Waste hay	340.9	309.7	23.8	26.0	25.6	6.5	145.6	107.8
	Consumed in crab grass hay	.....	2726.2	225.4	207.8	193.6	46.6	1226.3	1020.0
	Consumed in corn bran	.....	5953.9	138.5	624.0	620.8	378.1	4191.3	621.9
	Total consumed	.....	8680.1	363.9	831.8	814.4	424.7	5417.6	1641.9
815	Total solid Excrement	11875.8	2971.8	296.6	430.3	422 9	146.2	1463.3	635.4
	Total digested in 10 days	.....	5708.3	67.3	401.5	391.5	278.5	3954.3	1006.5
	Digested from crab grass hay	.....	1496.7	116.8	66.5	55.8	16.6	647.5	656.9
	Digested from corn bran	.....	4211.6	.....	335.0	335.7	261.9	3306.8	349.6
	Per cent digested from ration	.....	65.75	18.49	48.27	48.07	65.58	72 99	61 30
	Per cent digested from corn bran	.....	70.77	.....	53.69	54.08	69.27	78.90	56.21

TABLE IV—CONTINUED.

SHEEP NO. 4.

No. of Analysis		Total Amount. Grams.	Dry Matter. Grams.	Dry Matter Contains in Grams					
				Ash.	Protein N × 6.85.	Albuminoids (Alb. N × 6.25).	Fat (Ether Extract).	N-Free Extract.	Crude Fiber.
753	Crab grass hay fed in 10 day	3402.	3035.9	249.2	233.8	219.2	53.1	1371.9	1127.8
812	Corn bran fed in 10 days	7938.	7080.7	188.3	775.3	771.8	458.8	4918.3	739 9
	Total fed in 10 days		10116.6	437.5	1009.1	991.0	511.9	6290.2	1867.7
817	Waste corn bran in 10 days	14744.	1326.8	57.8	172.7	167.8	80.3	458.7	157.2
816	Waste hay in 10 days	12766.	1158.5	88.2	94.5	90.9	24.9	558 0	392.8
	Total consumed in 10 days		7631.3	291.5	741 9	732.3	406.7	5273.5	1317.7
818	Total Solid Excrement in 10 days	10732.1	2554.1	249.3	377 5	377.5	111.6	1263.0	552.7
	Total digested		5077.2	42.2	364.4	354.8	295.1	4010.5	765.0
	Digested from crab grass hay		1030.7	83 4	44.6	37.0	10.0	429.7	473.3
	Digested from corn bran		4046.5		319.8	317.8	285.1	3580.8	291.7
	Per cent digested from ration		66.53	14.47	49.12	48 45	72.56	76.05	58 06
	Per cent digested from corn bran		70.33		53.07	52.62	75.32	80.29	50 06
	Mean per cent digested from ration		66.1	16.5	48.7	48.3	69.1	74.5	59.7
	Mean per cent digested from corn bran		70 5		53 4	53.7	72.3	79.6	53.1

Mean nutritive ratio of crab grass hay and corn bran consumed in proportion of 1:2.33 of dry matter, 1:14.57. Mean nutritive ratio of corn bran 1:14.

TABLE V. CONTINUED.

SHEEP NO. 1.

No. of Analysis.		Total Amount. Grams.	Dry Matter. Grams.	DRY MATTER CONTAINS IN GRAMS. Ash.	Protein. (N×6.25).	Albuminoids. (Alb. N×5.25).	Fat (Ether Extract).	N Free Extract.	Crude Fiber.
829	Green rape fed in 10 days	68040.	9893.0	1452.3	2763.1	2163.6	420.5	4213.4	1043.7
822	Waste Green rape	1216.	225.6	75 6	52 20	37.7	7.5	64.6	25.7
	Total consumed		9667.4	1376.7	2241.1	2125 9	413.0	4148.8	1018.0
910	Total solid excrement in 10 days	6091.0	1774.3	674 6	304.6	291.0	240.8	388.4	165.9
	Total digested		7893.1	702.1	1936.5	1834.9	172 2	3760.4	852.1
	Per cent. digested		**87 65**	**51 0**	**86 41**	**86 31**	**41.70**	**90 64**	**83.70**

SHEEP NO. 2.

820	Green rape fed in 10 days	68040.	9893.0	1452.3	2763.1	2163.6	420 5	4213.4	1043.7
821	Waste rape	2690.	368.4	81.7	97.0	60.7	14.0	123.5	52.2
	Total consumed		9524.6	1370.6	2666.1	2102.9	406.5	4089.9	991.5
911	Total solid excrement in 10 days	7295.9	1866.3	730.1	307.6	295.6	227.9	444.4	156.4
	Total digested		7658.3	640.5	2358.5	1806.3	178.6	3645.5	835.1
	Per cent. digested		**80.41**	**46 73**	**88.46**	**85.90**	**43.94**	**89.11**	**84.23**
	Mean per cent. digested		**81 0**	**48.9**	**87.4**	**86.1**	**42.8**	**89.9**	**84.0**
	Mean per cent. digested by 4 animals		**84.8**	**62.7**	**88 8**	**86.4**	**48.5**	**92 0**	**87.0**

Mean nutritive ratio 2nd growth, 1:2.32. Mean nutritive ratio, 4 animals 1st and 2nd growth, 1:2.6.

TABLE V.—Showing Nutrients Consumed and Excreted in Grams With Percentages Digested.
(Fifth and Sixth Experiments, Digestion of Green Dwarf Essex Rape.)

Sheep No. 3.

No. of Analysis.		Total Amount. Grams.	Dry Mattter. Grams.	Dry Matter Contains in Grams. Ash.	Protein (N×6.25).	Albuminoids (Alb. N×6.25).	Fat (Ether Extract).	N Free Exuract.	Crude Fiber.
819	Green rape fed in 10 days	40818.	7543.2	985.9	1738.0	1223.5	333 4	3500.8	985 1
824	Waste rape	102.5	12.05	1.9	1.2	0.8	0.2	6.6	2.1
913	Total consumed		7531.15	984.0	1736.8	1222.7	333.2	3494.2	983 0
	Total solid excrement in 10 days	2258.5	871.8	240.6	159.2	154.7	151.2	222.1	102.2
	Total digested		6659.	743.4	1577.6	182.0	182.0	3272.1	880.8
	Per cent. digested		88 4	75 55	90 83	87 35	54 62	93 64	89 60

Sheep No. 4.

819	Green rape fed in 10 days	40818.	7543.2	985.9	1738.0	1223.5	333.4	3500.8	985.1
823	Waste rape	549.8	78.20	27.2	14 2	8.3	1.8	24.5	10.5
	Total consumed		7465.0	958.7	1723.8	1215.2	331.6	3476.3	974.6
912	Total solid excrement in 10 days	3470.5	852.2	215.9	180.8	171 1	153.4	208.3	93.8
	Total digested		6612 8	742.8	1543.0	1044.1	178.2	3268.0	880 8
	Per cent. digested		88.6	77 48	89.51	85.92	53.74	94 01	90.38
	Mean per cent. digested		88.5	76.5	90.2	86.6	54 2	93.8	90.0

Mean nutritive ratio 1st growth 1:2.95.

TABLE VI.—Showing Nutrients Consumed and Excreted in Grams with Percentages Digested.
(Digestion of Crab grass Hay and Rice Bran.)

Sheep No. 1.

No. of Analysis.		Total Amount. Grams.	Dry Matter. Grams.	DRY MATTER CONTAINS IN GRAMS.					
				Ash.	Protein (N × 6.25.)	Albuminoids (Alb. N × 6.25.)	Fat. (Ether Extract.)	Nitrogen Free Extract.	Crude Fiber.
753	Crab grass hay fed in 10 days	4538.	4049.7	332.5	311.8	292.4	70.9	1830.1	1504.5
917	Rice bran fed in ten days	4538.	4074.2	373.6	612.8	607.1	486.5	2108.4	493.0
	Total fed in ten days	9076.	8123.9	706.1	924.6	899.5	557.4	3938.5	1997.5
918	Waste rice bran	993.5	912.7	84.0	135.1	132.9	98.6	471.5	123.6
919	Waste hay	572.5	525.0	47.4	56.9	35.1	23.6	236.7	160.4
	Consumed in crab grass hay in 10 days		3524.7	285.1	254.9	257.3	47.3	1593.4	1344.1
	Consumed in rice bran in 10 days		3161.5	289.6	477.7	474.2	387.9	1636.9	369.4
	Total consumed in ten days		6686.2	574.7	732.6	731.5	435.2	3230.3	1713.5
914	Total Solid excrement in 10 days	9542.	2650.0	424.5	375.2	369.7	89.0	1070.3	690.9
	Total digested in 10 days		4036.2	150.2	357.4	361.8	346.2	2160.0	1022.6
	Digested from crab grass hay in 10 days		1935.1	147.7	81.6	74.1	16.8	841.3	865.6
	Digested from rice bran in 10 days		2101.1	2.5	275.8	287.7	329.4	1318.7	157.0
	Per cent. digested from ration		**60.37**	**26.14**	**48.79**	**49.46**	**79.55**	**66.87**	**59.68**
	Per cent. digested from rice bran		**66.46**	**00.86**	**57.73**	**60.67**	**84.92**	**80.56**	**42.50**

TABLE VI.—Showing Nutrients Consumed and Excreted in Grams with Percentages Digested.
(Digestion of Crab grass Hay and Rice Bran.)

Sheep No. 2.

No. of Analysis.		Total Amount. Grams.	Dry Matter. Grams.	DRY MATTER CONTAINS IN GRAMS.					
				Ash.	Protein (N × 6.25.)	Albuminoids (Alb N × 6.25.)	Fat. (Ether Extract.)	Nitrogen Free Extract.	Crude Fiber.
753	Crab grass hay fed and consumed in 10 days	4538.	4049.7	332.5	311.8	292.4	70.9	1830 1	1504 5
917	Rice bran fed and consumed in 10 days	4538.	4074.2	373.6	612.8	607.1	486 5	2108.4	493.0
	Total fed and consumed in 10 days	9076.	8123.9	706.1	924 6	899.5	557 4	3938 5	1997.5
915	Total solid excrement	12600.	3332.9	519.3	408.3	398.3	83.7	1371.5	950.2
	Total digested		4791.0	186.8	516.3	501.2	473.7	2567.0	1047.3
	Digested from crab grass hay		2223.3	172.2	99.8	84 2	25.2	966 3	968.9
	Digested from rice bran		2567.7	14.6	416.5	417.0	448.5	1600.7	78.4
	Per cent. digested from ration		58.97	26.46	55.84	55.72	84.98	65.18	52.43
	Per cent. digested from rice bran		63.02	3 91	67.97	68.69	92.19	75.92	15 90
	Mean per cent. digested from ration		59.7	26 3	52.4	52.6	82.3	66.0	56 0
	Mean per cent. digested from rice bran		64 7	2.4	62.9	64.7	88.6	78.2	29 2

Mean nutritive ratio of ration on basis of dry matter 1 of rice bran to 1.05 hay 1:10.13.
Mean nutritive ratio of rice bran 1:7.48.

	Number of Bulletin.	No. of separate determinations.	Animal used.	Dry matter.	Ash.	Protein.	Albuminoids.	Fats (Ether extract).	N-Free extract.	Crude Fiber.	Nutritive ratio 1:
Cotton-seed hulls,	87d	1	cow	35.9	27.1	24.6	.....	80.6	40 3	27.1	32.5
Cotton-seed hulls, (above included)	80c-87d	4*	cows, goats	39.8	19.9	67.5	67.5	85.1	36 9	43.1	106 6
Cotton-seed hulls and meal, 7 to 1	80c	1	cow	44.9	34.2	44.3	44 3	81.0	51.4	33 9	10.8
Cotton-seed hulls and meal, 6 to 1	87d	2	steers	46.4	25.4	45.8	45.1	82 1	49 7	40 2	9.71
Cotton-seed hulls and meal, 4 to 1	87d	2	steers	53.5	46.0	54.4	53.4	84 8	57.9	45.0	7.52
Cotton-seed hulls and meal, 3 to 1	97	1	steer	55.0	28 9	61.0	60 5	87.0	55 3	49.6	5 89
Cotton-seed hulls and meal, 2.8:1	97	1	steer	51.5	33.0	62.3	61.8	84.2	51.8	43.6	5.13
Cotton-seed hulls and meal, 2.4:1	97	1	steer	52.0	30.3	61.6	61.1	83 7	53.6	43.1	4 88
Cotton-seed hulls and meal, 2:1	97	2	steers	53.6	26 8	64 7	64.2	82 3	49.5	49.5	4.27
Cotton-seed hulls and meal, 1.99:1 and 1.81:1	118	2	steers	55.1	38.3	64.0	64 0	84.2	54.8	46 2	3.77
Cotton-seed hulls and meal, 1.5:1 and 1.54:1	118	2	steers	56.0	33.9	65.1	65.1	85.3	56 4	47.7	3 18
Cotton-seed meal with crimson clover hay	97	4	.....	73 3	31.5	87 8	87.1	89.7	61.5	46.4	1 38
Cotton-seed meal with sorghum Bagasse	97	1	.....	65 0	3.0	85.5	85.7	92.	55.1	.....	.....
Corn meal alone	97	1	goat	86.9	....	66.9	66.9	80.5	94.2	....	14 02
Corn meal in rations with crimson clover hay	97	2	goats	92.4	46.0	58.6	.....	97.7	100.0	18.2	.....
Corn and cob meal with crimson clover hay	97	2	goats	78.6	.....	45.9	.....	83 5	89.4	43.6	.....
Corn and cob meal alone	97	1	goat	78.7	.....	65.2	71.3	84.6	85 8	47.7	13 2
Corn silage alone	87d	1	cow	53.2	26.9	34.4	26.4	66 0	60.5	43.2	19 96
Corn silage and cotton-seed meal, 12:1	87d	2	goats	63 2	14.7	63.3	61 1	85.0	67.6	56.2	6.29
Corn silage and cotton-seed meal, 8:1	87d	2	steers	70.5	36.0	70.9	67.9	80.2	75 5	61.3	4.98
Corn silage and raw cotton-seed, 2.66:1	87d	2	cow, goat	60.0	34.9	58 6	55.4	85.4	55 4	59.9	9 12
Cotton-seed raw	87d	2	cow	66 1	43.3	67 9	63.6	87.1	49.6	75 5	7 13
Cotton-seed roasted	87d	2	steer, heifer	55.9	.....	47.0	44.2	71.7	51.4	65.9	9.19
Corn silage and cotton-seed roasted 2:1	87d	2	heifer, steer	55.6	5.9	43.2	40.3	71.2	57 1	53.0	11.77
Cat-tail millet	97	2	goat	62.3	68.4	62.6	41.5	46.1	59 1	66.5	6.15
Cowpea vine hay	87d	2	cow, goat	59.2	45.1	64.5	47.5	50.0	70.7	42 9	5.27
Crimson clover hay	87d	2	goat, sheep	62.2	53.6	69.1	60.2	48.8	71.5	48.7	3.76
Crimson clover hay (1 year old)	97	2	cow, goat	61.1	59 4	68.2	61 1	43 3	66 6	51 4	4 47
Crimson clover hay and cotton-seed meal, 6.4 to 1	97	1	cow	61.9	54 3	74.2	69.8	68.0	64 1	51.2	3.73
Crimson clover hay and cotton-seed meal, 3.09 to 1	97	1	goat	66.9	54 3	81.3	78 9	75.4	67.5	55 0	2.68
Crimson clover hay and cotton-seed meal, {3.53 to 1 / 3.5 to 1}	97	2	cows	63.4	54.1	74.8	71.6	71.2	66.4	49.3	2.81

*Including cow given above.

SUMMARY OF COEFFICIENTS OF DIGESTIBILITY—CONTINUED.

	Number of Bulletin.	No. of separate determinations.	Animal used.	Dry matter.	Ash.	Protein.	Albuminoids.	Fats (Ether extract).	N-Free extract.	Crude Fiber.	Nutritive ratio.
Crimson clover hay and corn meal, 1 83:1	97	1	goat	73 6	62.1	70.6	.....	72.4	83.8	50.9	6 64
Crimson clover hay and corn m al, 2 36:1	97	1	goat	69.0	41.8	62.3	.....	68.2	81.3	47.2	6 77
Crimson clover hay and corn and cob meal, 1:1.35	97	1	goat	70.4	49 1	59.3	.....	66 9	80.3	56.8	10.04
Crimson clover hay and corn and cob meal, 1.8 to 1	97	1	goat	65.7	44.7	63 7	.....	62.2	76.8	44.1	6.58
Soy bean hay	97	2	cow, goat	62.4	23.7	71.1	54.2	29.2	68.8	60 8	3 55
Soy bean silage	87d	2	goats	59.0	56.7	75.8	66.1	71.9	52 0	54.8	4.22
Pulled fodder (corn leaves alone)	87d	2	sheep, goat	55.5	13.5	56.0	52.5	63.0	58 9	60.7	8.73
Johnson-grass hay	97	1	goat	54 5	56.1	44.7	39.6	39.5	54 4	57.8	14 22
Peanut-vine hay	97	2	goats	59 9	20 4	63.3	53.0	65.9	69.5	51 9	7.69
Sorghum bagasse	97	1	goat	60 6	13.4	13.7	2.6	46.4	64.8	63.8	120 8
Sorghum bagasse and cotton-seed meal, 1.86 to 1	97	1	goat	62.2	7.1	77.8	77.3	84.5	62.5	54.1	4 19
Sorghum fodder (leaves alone)	97	2	cow, goat	63.1	29.5	60.8	45.1	46.7	64.5	70 4	8.94
Crabgrass hay	160	2	sheep	54.9	51.8	32.0	28.8	35.6	52.8	64.4	19 5
Crabgrass hay	148	4	sheep	50.7	44.4	.....	.....	42.6	51.0	58.4	99 5
Timothy hay	148	2	sheep	51.2	23.0	33 5	.....	17.6	58.0	48.0	26.1
2. Timothy hay and cotton-seed meal* †16:1 ‡15.15:1	148	2	sheep	55.3	22 8	50.7	.....	50.1	62.1	48 9	12.4
3. Timothy hay and cotton seed meal* †12:1	148	2	sheep	53.6	21.2	55.9	55.7	64 1	59.9	47.2	9 9
4. Timothy hay and cotton-seed meal* †8:1 ‡7.91:1	148	2	sheep	48 9	10.4	54.9	58.4	61.5	55.0	41.7	7 72
5. Timothy hay and cotton-seed meal* †4:1 ‡3.95:1	148	2	sheep	51.5	.....	60.6	63.1	74.7	57.3	42.7	5 3
6. Timothy hay and cotton-seed meal* †2:1	148	2	sheep	59.1	14.7	71.4	73.9	84.9	66 9	39.5	3.5
7. Timothy hay and cotton.seed meal* †1:1	148	2	sheep	61.4	27.4	75 6	79.2	89.0	68.8	27.8	2.34
Timothy hay, second lot	148	2	sheep	54.2	28 7	35.1	36.0	49.2	66.1	42.2	25 3
Crabgrass hay and pea meal ‡1:1.03	160	2	sheep	70.9	45.9	70.5	69.8	54.7	76.5	64 3	.....
Pea meal	.....	2	.....	86.6	33 5	82.0	82.0	73.9	93.1	64 0	.....
Crabgrass hay and corn bran ‡1:2.33	160	2	sheep	66.1	16.5	48.7	48.3	69.1	74 5	59.7	14.57
Corn bran	.....	2	.....	70.5	.....	53 4	53.7	72.3	79.6	53.1	14.0
Crabgrass hay and rice bran ‡1:1.05	.....	2	sheep	59.7	26.3	52 4	52.6	82.3	66.0	56.0	10.13
Rice bran	.....	2	.....	64.7	2.4	62.9	64.7	88.6	78.2	29.2	7.48
Green rape, first cutting	.....	2	sheep	88.5	76.5	90.2	86.6	54.2	93.8	90.0	2.95
Green rape, second cutting	.....	2	sheep	81.0	48 9	87.4	86.1	42.8	89.9	84.0	2.32
Green rape, mean of above	.....	.....	.....	84 8	62.7	88 8	86.4	48.5	92.0	87.0	.....

*Digestibility of Timothy hay was calculated for each experiment. †Fed. ‡Consumed on basis of dry matter.